## CLAIMS

What is claimed is:

1. A method for producing a thin sample band in a microchannel system, said method comprising the steps of:

a.) providing a junction formed at an intersection of at least four transport channels lying in a common plane, said channels having first and second ends, said channel first ends contiguous with said junction, said first and second channels substantially co-linear along a primary axis, wherein said third and fourth channels lie on opposite sides of said primary axis;

b.) filling each of said channels and junction with a transport medium;

c.) inserting a band of a sample material into a region near said first channel first end, said material comprising one or several species; and

d.) applying electric fields along each of said channels in order to induce transport of said species, said transport causing said sample band to expand into said junction toward said second, third and fourth channels such that portions of said band enter said third and fourth channels thereby causing said band to be stretched and thinned while traversing said junction.

2. The method of claim 1, wherein the step of applying electric fields further includes the step of altering said electric fields along said first, second, third and fourth channels such that said thinned sample band is injected into one of said first or said second channels.

3. The method of claim 1, wherein the transport medium is a fluid.

4. The method of claim 3, wherein said electric fields produce electroosmotic motion of said transport medium thereby causing said sample band to be carried along with said transport medium.

5. The method of claim 3, wherein some of said species comprise ionic species and wherein said electric fields produce combined electroosmotic motion of said transport medium and electrophoretic motion of ionic species within said sample band thereby causing said sample band to move with, and relative to, said transport medium.

6. The method of claim 1, wherein the transport medium is substantially stationary.

7. The method of claim 6, wherein said species comprise ionic species and wherein said electric fields produce electrophoretic motion of said ionic species relative to said transport medium thereby causing motion of said sample band through said channels and junction.

8. The method of claim 1, wherein said channel second ends are each connected to separate reservoirs, said reservoirs each containing electrodes connected to an electrical power supply, said power supply used to control said electric fields along each of said channels.

9. The method of claim 1, wherein the step of applying is performed such that said electric fields along said third and fourth channels are the same, resulting thereby in transport of equal portions of said sample band into said third and fourth channels such that said sample band remains symmetric about said primary axis.

10. The method of claim 1, wherein said third channel comprises a supply channel in physical and electrical communication with a supply reservoir, and wherein said fourth channel comprises a waste channel, said waste channel in physical and electrical communication with a waste reservoir, said supply reservoir containing a quantity of said sample material.

11. The method of claim 10, wherein said step of inserting, comprises the steps of:

a.) applying first electric fields along said third and fourth channels thereby transporting said sample material along said third channel and into said fourth channel, thereby filling regions of said first ends of said first and second channels proximal to said junction with portions of said sample material;

b.) removing said first electric fields;

c.) applying second electric fields along said second, third and fourth channels thereby transporting said sample material out of said junction and first end of said second channel and into said third and fourth channels, such that a sample band remains in said first channel first end contiguous with said junction; and

d.) removing said second electric fields.

12. The method of claim 10, wherein said step of inserting, comprises the steps of:

a.) applying first electric fields along said third and fourth channels thereby transporting said sample material along said third channel and into said fourth channel, thereby filling regions of said first ends of said first and second channels proximal to said junction with portions of said sample material;

b.) removing said first electric fields;

c.) applying second electric fields along said first, second, third and fourth channels in order to transport said sample material out of said junction and first end of said second channel and into said first, third and fourth channels, such that a sample band remains in said first channel first end contiguous with, or proximal to, said junction; and

d.) removing said second electric fields.

13. A method for inserting a sample band into a microchannel system, said method comprising the steps of:

a.) providing a microchannel system comprising at least four channels and a junction formed at an intersection of said channels, said channels lying in a common plane, said channels having first and second ends, said channel first ends contiguous with said junction, said first and second channels substantially co-linear along a primary axis, wherein said third and fourth channels lie on opposite sides of said primary axis;

b.) providing a transport medium disposed within said channels and within said junction;

c.) providing reservoir means for introducing a sample into said microchannel system, said reservoir means being located at the second end of the third channel distal to said junction;

d.) providing a power supply and electrode means for connecting said power supply with said second end of each of said channels;

e.) providing means for controlling said power supply such that electric fields may be applied along each of said channels;

f.) applying first electric fields along said third and fourth channels thereby transporting said sample material from said sample reservoir, along said third channel, and into said fourth channel, thereby filling regions of said first ends of said first and second channels proximal to said junction with portions of said sample material;

g.) removing said first electric fields;

h.) applying second electric fields along said second, third and fourth channels thereby transporting said sample material out of said junction and first end of said second channel and into said third and fourth channels, such that a sample band remains in said first channel first end contiguous with said junction; and

i.) removing said second electric fields.

14. The method of claim 1, further comprising the step of applying electric fields along said first, second, third and fourth channels such that said sample band is transported from a region proximal to said second channel first end, and across said junction toward said first channel first end such that portions of said sample band enter said third and fourth channels thereby causing said sample band to be further stretched and thinned while traversing the junction.

15. The method of claim 14, further comprising the step of reversing the direction of said electric fields along said first and second channels at least once, such that said sample band is transported across said junction multiple times causing said band to thin additionally upon each traverse of said junction.

16. The method of claim 15, and wherein said sample band is initially inserted proximal to said first channel first end and wherein further the total number of reversal steps is odd such that said sample band is finally positioned proximal to said second channel first end.

17. The method of claim 15, wherein said sample band is initially inserted proximal to said first channel first end and wherein further the total number of reversal steps is even such that said sample band is finally positioned proximal to said first channel first end.

18. The method of claim 1, wherein said third and fourth channels are substantially co-linear along a secondary axis, wherein said secondary axis is perpendicular to said primary axis.

19. The method of claim 1, wherein each of said channels has a width.

20. The method of claim 19, wherein the widths of said channels are substantially the same.

21. The method of claim 20, wherein the junction formed at said intersection of said channels is square, and wherein each side of said junction is equal to said channel width.

22. The method of claim 19, wherein said junction has a height perpendicular to said primary axis which is greater than the smallest channel width.

23. The method of claim 19, wherein a width of said junction along said primary axis is larger than the smallest channel width.

24. The method of claim 19, wherein the width of at least one channel is less than about 1000 microns.

25. The method of claim 1, wherein a portion of said microchannel system comprises a separation matrix disposed therein.

26. The method of claim 8, wherein said electric fields are controlled by the step of:

applying an electric potential to each of said electrodes, each of said potentials having a magnitude and a polarity; and

by varying each of said potential magnitudes and polarities.

27. The method of claim 8, wherein said electric fields are controlled by varying a magnitude and a polarity of an electric current flowing to or from each of said electrodes.

28. A method for producing a thin sample band in a microchannel system, said method comprising the steps of:

a.) providing a junction formed at an intersection of at least four transport channels lying in a common plane, said channels having first and second ends, said channel first ends contiguous with said junction, said first and second channels substantially co-linear along a primary axis, wherein said third and fourth channels lie on opposite sides of said primary axis;

b.) providing a reservoir and an electrode means at each of said channel second ends;

c.) providing a power supply connected to said electrodes, said power supply for applying electric fields along said channels;

d.) filling said channels, reservoirs and junction with a transport medium;

e.) introducing a quantity of a sample material into said reservoir at said third channel second end;

f.) applying first electric fields along said transport channels in order to induce transport into said junction from the first, second and third channels, and out of said junction from the fourth channel, such that a stream of said sample material is transported along said third channel in a direction toward said fourth channel, and wherein said stream is narrowed and focused at said junction under the influence of said electric fields such that said narrowed sample stream continues to travel along said fourth channel away from said junction;

g.) removing said first electric fields;

h.) applying second electric fields along said third and fourth channels such that said direction of travel of said narrowed sample stream is reversed wherein a portion of said narrowed stream is transported through said junction and into said third channel;

i.) removing said second electric fields; and

j.) applying third electric fields along said four channels in order to induce transport into said junction from said first channel and out of said junction into said second, third, and fourth channels, such that a portion of said narrowed sample stream enters said second channel forming a thinned sample band.

29. A method for producing a thin sample band in a microchannel system, said method comprising the steps of:

a.) providing a microchannel system comprising at least four channels and a junction formed at an intersection of said channels, said channels lying in a common plane, said channels having first and second ends, said channel first ends contiguous with said junction, said first and second channels substantially co-linear along a primary axis, wherein said third and fourth channels lie on opposite sides of said primary axis;

b.) providing a transport medium disposed within said channels and within said junction;

c.) providing reservoir means for introducing a sample into said microchannel system, said reservoir means being located at the second end of the third channel distal to said junction;

d.) providing a power supply and electrode means for connecting said power supply with said second end of each of said channels;

e.) providing means for controlling said power supply such that electric fields may be applied along each of said channels;

f.) applying first electric fields along said third and fourth channels thereby transporting said sample material from said sample reservoir,

along said third channel, and into said fourth channel, thereby filling said junction with portions of said sample material;

g.) removing said first electric fields;

h.) applying second electric fields along said four channels in order to induce transport into said junction along said first and second channels and out of said junction along said third and fourth channels thereby axially stretching and thinning the band of sample material that remains within said junction

i) removing said second electric fields.

30. The method of claim 29 further comprising the step of:

Applying third electric fields along said four channels in order to induce transport into said junction from said first channel into said second third and fourth channels, such that a portion of said axially stretched and thinned sample band enters into said second channel.

31. An apparatus for analyzing or processing a sample, comprising:

a.) a substrate fabricated to include a microchannel system disposed therein, said microchannel system comprising at least four transport channels, said channels having first and second ends, said channels lying in a common plane, wherein said first and second channels are aligned substantially co-linear along a primary axis, and wherein said third and fourth channels lie on opposite sides of said primary axis;

b.) at least one junction formed at an intersection of said first ends of said at least four transport channels;

c.) reservoir means for introducing a sample into said microchannel system;

d.) one or more power supplies;

e.) electrode means connecting said one or more power supplies with said second end of each of said at least four channels;

f.) a transport medium disposed within each of said transport channels and within said junction;

g.) means for inserting a band of a sample material into a region near said first channel first end said material comprising one or several different species; and

h.) means for controlling said power supply so as to establish such electric fields along said at least four channels as to induce transport of said species at least partially across said junction at least once, said transport causing said sample band to expand as a continuous shell, wherein portions of said band enter said third and fourth channels causing said band to be stretched and thinned while traversing said junction providing thereby a sample band having a thickness of less than two channel widths.

32. The apparatus of claim 31, wherein each of said channels has a width.

33. The apparatus of claim 32, wherein the widths of said channels are substantially the same.

34. The apparatus of claim 33, wherein the junction formed at said intersection of said channels is square, and wherein each side of said junction is equal to said channel width.

35. The apparatus of claim 32, wherein said junction has a height perpendicular to said primary axis which is greater than the smallest channel width.

36. The apparatus of claim 32, wherein said width of said junction along said primary axis is larger than the smallest channel width.

37. The apparatus of claim 32, wherein the width of at least one channel is less than about 1000 microns.

38. The apparatus of claim 31, wherein a portion of said microchannel system comprises a separation matrix disposed therein.

39. The apparatus of claim 31, wherein said electric fields are controlled by applying an electric potential to each of said electrodes and then varying said potential magnitude and polarity.

40. The apparatus of claim 31, wherein said electric fields are controlled by varying a magnitude and a polarity of an electric current flowing to or from each of said electrode means.

41. The apparatus of claim 31, wherein said substrate is selected from the list consisting of silicon, silicon compounds, silicone, glass and polymers.